

of scientific publications. The world appears to be accumulating knowledge faster than it can be assimilated. Even by aid of the comprehensive bibliographies now issued, it is difficult, if not impossible, for the specialist to become conversant with the current literature of his own field. On the other hand, the standard of excellence in publications is undoubtedly higher now than at any previous epoch, although it may not have kept pace adequately with the increasing productivity of our times.

### SOME LONDON PROBLEMS.

#### LONDON'S TRAFFIC.

THE deputation a short time ago from Browning Hall to the London County Council, and the numerous references which have been made in Parliament and elsewhere to the question, make it appear likely that before very long steps will be taken by the Government to establish a Traffic Board for London. In fact, the President of the Board of Trade has given us to understand that his department is in favour of it, and that he will endeavour to get the matter settled without delay; for the new Traffic Department of the Board of Trade cannot be anything but a temporary step.

Among the mass of valuable information collected by the last Royal Commission not the least interesting was that dealing with the history of this problem, for the London traffic problem is almost as old as the city itself. From the earliest days London has suffered from the congestion of its narrow streets, arising from the accumulation of traffic and the encroachments of buildings, and just as at the present day so in previous centuries every attempt made to widen individual streets or to provide increased facilities led to such an increase of traffic in that particular avenue as to render the final state of congestion worse than before. Nothing is more characteristic of the traffic problem than this phenomenon, that every increase of facilities produces an increase of traffic, and so on.

Spasmodic attempts had been made by the corporation of London and other bodies to widen streets here and there, and during the earlier part of the seventeenth century several proposals were brought forward, but were shelved owing to the state of politics at the time.

After the Restoration, however, and just before the Great Fire, an Act was passed for repairing and enlarging the streets with the express object of improving traffic, stating that many streets were too narrow for vehicles. It is interesting to note, however, that increased traffic was anticipated, and the Act also provided for the regulation and licensing of hackney carriages; but immediately after came the plague and the fire, after which a new Act was passed. This was London's great opportunity, and both Sir Christopher Wren and John Evelyn brought forward comprehensive schemes for rebuilding. Had either of these been followed, untold millions would have been subsequently saved to London. It would to-day have been one of the most orderly and carefully laid out cities, with great avenues radiating from the centre. Had this taken place the subsequent growth of the suburbs would have naturally followed on the same plan, and the present heterogeneous arrangements of suburban streets would have never grown up.

In the eighteenth century the conditions were very analogous to those of the nineteenth. If we suppose mail coaches for railways, riding horses for bicycles, hackney carriages for cabs and motors, we see that London was even then provided with a considerable variety of means of transport.

The first Parliamentary Committee upon metropolitan traffic met in 1830, the matter being brought into prominence by the imminence of railways being built in the London district. Other committees succeeded, and in 1842 a Royal Commission was appointed under the Earl of Lincoln, the Commissioner of Woods and Forests, as chairman; various improvements were therein suggested, but it was not until 1853 that Parliament gave a definite start to the modern idea of London local government.

In 1845 the need of improved means of locomotion were realised, and no fewer than nineteen Bills were promoted in that year dealing with railways in the metropolitan district, at least one of them containing the suggestions for a metropolitan central station.

Not until 1854, however, did the first underground line from Paddington to Farringdon Street receive Parliamentary sanction. It was opened in 1863, and was followed by the construction of a similar line from Victoria to Kensington in 1868, but the inner circle was not completed until 1884.

#### LONDON'S PORT.

The chief difficulty under which London suffers in connection with its port, as in connection with so many other matters, arises from its age. It is so much older than its rival ports that steps which are taken by them so as to keep them up to date are rendered far more difficult in the case of London. Nothing is easier than to point to Rotterdam or Liverpool as examples of what might be done, but those who do so too often forget the fact that the Port of London has a history of 500 years, compared with less than a century of serious trading in those other ports. The Port of London question is a good, nay, one of the best, examples of the truth that "circumstances alter cases."

The result is that there are an inordinate number of authorities concerned in dealing with the question, and an inordinate number of vested interests to be considered. Moreover, the conditions of transport have changed very materially. In the Middle Ages London was the *entrepôt* for the whole of western Europe. The East Indianmen unloaded there, and their cargoes were distributed by smaller vessels over the whole of western Europe. At the beginning of the nineteenth century, however, trade began to go to other ports. The rise of Liverpool, Glasgow, Hamburg, Antwerp, &c., means that the population surrounding those ports are now no longer supplied from London. Nevertheless, the great increase of population in London itself and all England as a whole, maintains the actual amount of traffic coming into London at its former figure, and London acts as a distributing centre for 10,000,000 to 12,000,000 persons.

The control of the Thames is in the hands of the Thames Conservancy, the dock companies, the Trinity House, the Corporation of the City of London, and the County Council, while the wharfingers and lightermen also have most important interests.

In Liverpool, on the other hand, or in Glasgow, the Harbour Trust has practically a monopoly of authority, and this enables a policy to be adopted which is far less trammelled by outside interference.

Certain of the docks in London are so old that it is impossible to think of modernising them in any way, but the India Docks could undoubtedly be very much improved, while the Tilbury Docks are said to be capable of docking nearly any ship at present afloat. The problem of docking, however, is one that has to be constantly altering on account of the growth of steamships. Hence docks, if they be large enough to-day, would, in a few years' time, be too small, and any docks which are now constructed, in order to have something in hand, need to be of the order of 1000 feet in length. It is not, however, in length that the docks are so much lacking in London, but in the depth of the sills, which render it impossible for vessels of more than 30 feet to enter, for the Royal Albert Dock can take ships up to 536 feet long.

New York and Boston are arranging for 40-foot channels into their ports and steamers are to-day leaving Baltimore loaded down to 32 feet, whereas, at the present time, a ship drawing only 28 feet may be delayed for five hours in the Thames on any day.

What is really wanted is a channel at least 30 feet deep at low tide and 1000 feet wide, as far as the Albert Dock gates, and 1000 feet is not at all too wide to allow a 750-foot vessel to be turned.

Numbers of schemes are constantly being brought out dealing with the port, such as the Thames Barrage Scheme of last year, in which the whole river was to be docked

from Gravesend upward, providing for deep-water quays. Less ambitious proposals are the docking of the River Lea and the provision of jetties at Canvey Island, and minor alterations of the docks. All these are, however, matters which should be dealt with by the Trust if one be appointed.

#### LONDON'S ATMOSPHERE.

Several causes have recently combined to direct attention to the question of London's atmosphere. The memorandum issued last year by the First Commissioner of Works relating to the damage done to vegetation in the parks, the recent report by the L.C.C. upon the regulation of the smoke nuisance, and the invention of several smokeless fuels, have alike brought home to the public the fact that we have as yet only touched the outskirts of the problem of smoke nuisance. Useful as the various palliatives suggested may prove, consideration of them must always ultimately lead to the fundamental question, Why should any fuel be burned in London at all?

From its position in the Thames Valley, London will probably always be subject to white fogs, and the presence of six million human beings and numerous animals must always be the cause of great pollution of the atmosphere. There is all the more reason, therefore, for seeking some way of reducing or removing the present consumption, within the metropolitan area, of nearly fifteen million tons of fuel annually. Regulations and the use of smokeless fuels would undoubtedly be a move in the right direction, and might to some extent reduce the amount of the visible products of combustion. They would, however, hardly affect that equally important side of the problem, the production of carbonic and sulphurous acids. To do this to any considerable extent means the ultimate abolition of the consumption of fuel in the metropolitan area. Utopian as such a step may appear at the present time, the evidence tendered before Parliament during the past few years in connection with the proposed supply of electric power shows that the establishment of a large central system would have undoubtedly tended in this direction.

This result involves two steps:—

First, the reduction, by the adoption of improved methods, of the total quantity of coal burned to produce the power required in the metropolitan area; and, secondly, the removal of the place of combustion to the metropolitan limits.<sup>1</sup>

These two results can only be secured by the general substitution of electric power for other forms.

Let us now consider to what extent it is to-day practicable for electricity to replace the direct combustion of coal in various industries.

Owing to the high price of electricity, the use of gas for street lighting is in many cases still quite as cheap as the electric light, while there are still many parts of London where power derived from gas engines is even cheaper than the supply of electric power at present available; but the abolition of gas for lighting the streets and for driving gas engines will certainly follow its abandonment for lighting purposes in good private houses, if only the price of electricity be reduced sufficiently low. The flame arc lamp, containing as it does the necessary rays for piercing a fog, removes the objections which apply both to ordinary arc lamps and to incandescent mantles, and is the most suitable system of lighting for important streets which one could have. If electricity were available in London at a maximum price of  $\frac{3}{4}$ d. a unit for street lighting, there would be a great saving effected over every other system of lighting now in use. At the present time, however, interior electric lighting is chiefly used in the West End and in large shops and offices where the price is a secondary consideration, while public lighting is only done widely where the municipality itself provides the current. It cannot be said to have penetrated

the poorer quarters in the way that gas has done by means of penny-in-the-slot meters, which it was recently stated bring in to the Gas Light and Coke Company 1,000,000l. per annum; but at  $1\frac{1}{4}$ d. to 2d. per unit, electric light would certainly be cheaper than any gas which is being sold in the metropolitan area to-day.

The adoption of electricity for suburban traffic is long past the experimental stage, and provided power can be obtained sufficiently cheaply, there is nothing to prevent all the railways in London being driven electrically. The experience already obtained on the North-Eastern Railway, where the heavy suburban traffic is handled electrically, or at Liverpool or on the Underground Railway, has shown this. That the haulage of main-line trains by electricity in suburban areas is also feasible is proved by the fact that the two most important railway companies in New York—the Pennsylvania and the New York Central Companies—have arranged to haul the whole of their main-line trains by electric locomotives while in the suburban districts.

Nearly half the cost of operating suburban services by electricity is due to the cost of the power, while in many cases the capital outlay on the generating station forms half the total cost of the electrification. Thus the price of electricity and the difference in capital outlay between the erection of independent stations or its avoidance may make all the difference between it being commercially feasible to electrify or not; but at the present time there is no means by which the railway companies of London can get a suitable supply except by putting up stations for themselves. The supplies which are at present in existence are on too small a scale, and were primarily intended for lighting purposes. Moreover, as the law stands, the majority of the electric lighting authorities can only supply for use in their own areas, so that the railway companies would be obliged to purchase their supplies piecemeal along their routes. As there are twenty-one different systems in London, the impracticability of this, for this reason alone, is obvious. The cost of electrification under these conditions would, of course, be out of the question. In order to be really satisfactory the price of power should be of the order of  $\frac{1}{4}$ d. per unit. On the Tyne, the North-Eastern Railway Company pays rather more than this, but in London the higher cost of coal would be far more counterbalanced by the enormous output. The average consumption of locomotives at the present time is 4 lb. to 5 lb. per horse-power, as against 2 lb. per horse-power in a central generating station. It has been estimated that the total horse-power required for operating the present suburban line traffic in the London district would be 120,000, while the suburban traffic on main lines would take another 30,000, and that an annual production in all of some 600,000,000 Board of Trade units would be needed. As a matter of fact, a larger output would probably be required, because one of the chief objects of electrification is to enable a more frequent service to be run; but as the total output of the London electric lighting stations last year was of the order of 150,000,000 units, it is obvious that one cannot look to them for a supply for this purpose even if they were all united into one station and supplying on one system, instead of supplying from more than fifty stations with more than twenty systems. It is a question of price, and the price is one the existing systems cannot supply at.

Coming now to the factories, it will be noted that these account for nearly one-half of the coal consumption of London, and probably for three-quarters of the smoke and deleterious fumes; yet these offer the best field for electric power of any, for the possibility of driving factories electrically has been conclusively demonstrated on the Tyne, where, practically speaking, every factory and shipyard on the north bank of the river obtains its supply from the power company which is there in operation. Power is applied to all kinds of purposes. The three-phase electric motors, which contain no exposed electrical parts, work without trouble in the most exposed conditions.

Cranes, both stationary and travelling, are more conveniently operated by electric motors than by the old vertical boilers and engines. In fact, there are practically

<sup>1</sup> So far as gas consumption goes this question of removal has partly taken place already. In place of the seventeen or eighteen gas companies with works scattered throughout London which are shown on the old Ordnance maps, there are now practically three authorities, and by far the larger part of the coal consumption to make gas for London is used on the Greenwich Marsh or at Beckton.

no uses to which the electric motor does not lend itself in factories.

The objection which is often raised, however, to the replacing of steam-driven machinery by electricity, especially in chemical works, breweries, soap works, &c., is that the steam is required for heating and boiling; but here, again, it is a question of price only; the chief chemist of one of the most important soap makers in the east of London recently stated that it was purely a question of price for him to use electricity for boiling purposes instead of steam, and he estimated that it would pay him to do this if he could obtain it at not more than  $\frac{1}{4}$ d. per unit.

Now a certain number of London factories are already supplied from the existing lighting stations. So great are the benefits of electricity that it has paid people to adopt it even although electric energy is so expensive, for so long as electricity is provided from electric lighting stations as an adjunct, so long must it necessarily be expensive; but the wholesale adoption of electricity in factories on the scale that it has taken place on Tyneside can only take place when electricity is produced on an enormous scale, and is used for all purposes in the district. Hitherto, power has been supplied as a bye-product of electric lighting, and this accounts for the fact that out of 555,000 horse-power required to drive the factories in the industrial districts of London, only some 26,000 or 27,000 horse-power of electric power is obtained from the present stations.

This great field that remains can only be tapped by putting down a system for the express purpose of supplying the power needs of East London; while such a scheme must, in order to produce cheaply, have as great a variety of consumers as possible, it cannot hope to be completely successful if it is made an adjunct of electric lighting or electric traction. Power supply must be the first aim of the undertaking, even although in the process of getting a power supply an even greater load may be obtained from the supply to railways.

The consumption of coal in domestic fires accounts for 4,570,000 tons a year, or 25 per cent. of the total consumption. Electric heating has hitherto been very little used, and even in America is confined to the heating of tramcars and workshops in places where it is only a question of the cost of electric energy is undoubted, and that electricity forms a most convenient agent in heating and cooking, and can replace all other forms, is now generally admitted. The reason is this, that whereas the ordinary gas fire only, as a rule, gives out from one-half to one-third of its heat usefully, while the best stove probably does not give out more than about 75 per cent. of its heat, the efficiency of the electric radiator is practically 100 per cent. It can be shown that if the cost of electricity be 1s. 3d., it is as cheap for cooking as gas at 3s. per 1000 feet; but to compete with coal at 25s. a ton for heating, electricity must be supplied about  $\frac{1}{4}$ d. per unit. In a number of houses already electric radiators are being adopted on account of their convenience, even though they cost somewhat more than gas fires; with cheap electricity they would be adopted universally.

Thus, although electricity for heating and cooking has been looked upon as a purely Utopian proposal, as a matter of fact the time is not far distant when it will be found quite as cheap as any other form of heating. It is true that an electric radiator in its present form, although efficient in itself, converts but a very small portion of the energy of the coal into heat; but this is, of course, due to the inefficiency of the present methods of producing electricity, and there can be little doubt that we shall before very long witness a very considerable improvement in this respect. Whereas the best modern turbines and boilers convert only 15 per cent. of the energy of the coal into electricity, the internal combustion engine converts 35 per cent.; but even at the present time such are the advantages of electricity for heating and cooking, such is its applicability, such is the cost of re-decorating and cleansing in London, that at prices considerably higher than those above stated electricity would be as cheap to adopt as coal or gas. The question again resolves itself into one of price.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Goldsmiths' Company has resolved to make a grant of 10,000l. for the purpose of founding and endowing a readership in metallurgy, such readership to be associated with the name of the company. It is hoped that research and other work in the precious metals, and the theory and practice of assaying, will be kept somewhat prominently in view in connection with the proposed readership.

Mr. R. H. Biffen has been elected to the recently established chair of agricultural botany. Mr. Biffen is the author of numerous papers, the earlier of which dealt with the preparation of india-rubber and the coagulation of latex, and he has devoted a great deal of attention to fungi. His researches on the hybridisation of wheat and barley have attracted the attention of civilised Governments throughout the world, and attempts have been made to induce him to leave England and place his services at the disposal of at least one foreign Government. It is satisfactory that largely owing to the generosity of the Drapers' Company Mr. Biffen will be able to continue to carry on his researches in Cambridge.

Mr. C. L. Boulenger has been appointed assistant to the superintendent of the museum of zoology from March 25 to September 30, 1908.

ON Friday evening, March 13, Lord Alverstone distributed the certificates and prizes at the South-Western Polytechnic Institute, Chelsea. The report of the principal to the governing body showed that the session 1906-7 had been a very successful one, the highest honour obtained being the D.Sc. degree of Mr. Crocker, who had done all the necessary chemical research in the institute. In the course of a short address, Lord Alverstone laid great stress on the necessity for concentration in study. The development of any one subject is so great at the present time that the utmost concentration of thought is required to advance knowledge. He took as illustration the discoveries of Lord Kelvin in regard to the mariner's compass.

THE reports for the year ending June 30, 1907, of the librarian of the U.S. Congress and of the superintendent of the library building and grounds have been received from Washington. As indicative of the generous scale on which this great American library is subsidised, it may be stated that the appropriations made for the present year reach 123,000l., and that the salaries to be paid during the year for the various officers reach 69,570l. In 1907 the number of books in the library reached 1,433,848, representing a gain of 54,604 over the previous year. In addition there were nearly 100,000 maps and charts and a quarter of a million prints. The most important accessions to the library were the Yudin library, consisting of 80,000 works relating to Siberia and Russia, and a notable collection of the literature of Japan, consisting of some 9000 works.

A BILL to promote agricultural education and nature-study in public elementary schools, introduced in the House of Commons by Mr. Jesse Collings, was read a second time on March 11. The object of the Bill is to provide for the teaching in all public elementary schools of agricultural and horticultural subjects; to give facilities for nature-study, and generally by means of object-lessons to cultivate habits of observation and inquiry on the part of the pupils. To this end the Bill provides for school gardens and such collection of objects as may be necessary for the practical illustration of the instruction given. The education specified in the Bill, while optional in urban schools, is to be compulsory in all schools situate in rural and semi-rural districts. A special grant, not exceeding 75 per cent. of the cost, is provided for in the Bill towards the expenses of local education authorities in carrying out the provisions of the Bill.

In his capacity of Chancellor of the Bombay University, Sir George Clarke presided at the recent annual Convocation of the University and delivered an address. From a report of his speech in the *Pioneer Mail* we learn that